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GB 1596134 A US 4094217 A

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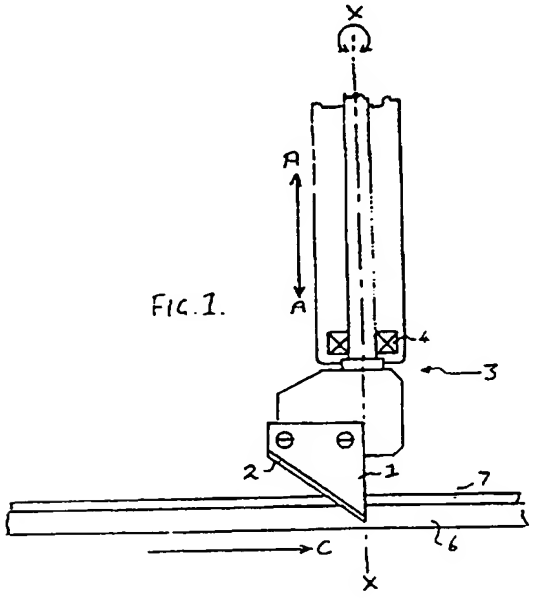
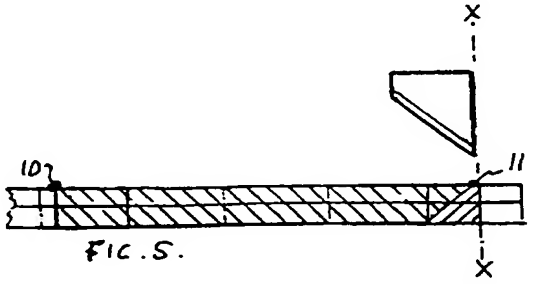
(54) Abstract Title
Apparatus for cutting sheet material

(57) Apparatus for cutting sheet material 7, such as polycarbonate, comprises a carrier bed 6. A blade carrier 3 is mounted for movement C relative to the bed, is rotatable about an axis X which is normal to the bed and is movable vertically along its axis X. A blade 1 is mounted on the blade carrier and has an edge 2 which is angled obliquely to the sheet 7. The blade is drawn across a sheet to be cut from one side 10 to the far side 11. The lower part of the blade does not make a complete cut at the far side. The blade is removed from the sheet and rotated through 180° and then forced down into the sheet to cut the sheet at its edge. Control means enables the cutting operation to be conducted automatically.



FIC. 1.



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The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

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"Apparatus for and methods of cutting sheet material"

The present invention relates to apparatus for and methods of cutting sheet materials, particularly thick or composite materials requiring a significant depth of cut.

Polycarbonate sheeting is often supplied for conservatories and similar structures where the sheeting consists of two layers which are spaced apart by about one centimetre via longitudinal transverse partitions to provide a structurally rigid material with good insulating properties.

Conventional methods of cutting using circular saws, jigsaws or routing machines produce large amounts of waste material which has to be cleaned up, are difficult to control with accuracy and can give rise to splitting.

We have attempted cutting such materials using an oblique cutting blade in a drawn cutting operation, i.e. with the blade in a lagging configuration with respect to the workpiece, which applies a shear force to the material and thereby aims to provide a clean cutting action. An example of this form of cutting action occurs when using the so-called Stanley knife (registered Trade Mark) in cutting decorative laminates.

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A problem which arises in cutting in this manner is that since the blade has to be operated in a lagging configuration with the blade at an oblique angle to the workpiece, the outer surface of the material is cut in advance of material which is deeper down.

If then a piece of material with straight edges, for example of rectangular or triangular configuration in plan view has to be cut, it is not normally possible to obtain a square cut at the corners, and so if the cut line at the greatest depth of cut extends as far as the corner, the cut line on the outer surface extends beyond the corner or the cut at the corner is oblique. This results in an unsatisfactory finish or creates wastage in adjacent sheets of material.

The present invention aims to overcome this problem.

Accordingly the invention provides:

apparatus for cutting a workpiece of sheet material comprising a carrier bed for carrying the workpiece,

a blade carrier located transversely to said carrier bed and arranged to move to and fro along an axis transverse

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to said carrier bed, and being rotatable about said axis,

a cutting blade carried by said blade carrier and having a cutting edge located in a lagging configuration at an oblique angle to said longitudinal axis,

driving means for provision of relative movement between the carrier bed and the blade carrier to enable a line of cut to be achieved, and

control means for controlling movement of the cutting blade relative to the carrier bed to provide a line of cut between first and second points on the workpiece by starting the cut with a first cut from said first point by cutting in a direction towards said second point, and completing the cut line by starting from said second point with a second cut and cutting in a direction towards said first point.

The cutting blade should be orientated with its cutting edge in a lagging configuration with respect to the workpiece, i.e. at an angle of significantly less than 90°, during formation of the cut from the first point towards the second point, and should then be turned through 180° about said longitudinal axis so as to again be in a lagging configuration when the cut from the

second point towards the first point is formed.

Preferably the cutting blade has a straight cutting edge at its front edge which is disposed at said lagging cutting angle, and a rear edge which is aligned with said longitudinal axis and hence is transverse, and preferably perpendicular, to said carrier bed. The rear edge does not necessarily have to be perpendicular to the carrier bed but can be re-entrant if required, i.e. it should not extend rearwards of the longitudinal axis otherwise it could interfere with the cutting operation.

In order to ensure adequate support for the cut material, it is preferable for the first cut to extend the whole way from the first point to the second point, and for the second cut to deal only with a residual triangular zone under the end of the first cut in the region of said second point. Aso this means that on the outer surface the problem of two cut lines having to meet accurately does not arise.

In order to locate the cutting blade in a disposition for making its second cut, it is preferred that the following steps are made:

i) on completion of the first cut the blade is removed

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from within the workpiece by transverse movement of the blade carrier,

ii) the blade carrier is rotated through 180° so as to present the cutting blade in the reverse direction,

iii) the blade carrier is displaced by an amount which brings the longitudinal axis of the blade into alignment with said second point, and

iv) the blade is re-introduced into the workpiece in order to complete the cut line. In this the order of steps ii) and iii) is not critical, i.e. step iii) can preceed or succeed ii), or the two can occur at overlapping times.

An embodiment of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings.

Figure 1 shows a side elevation of the significant part of a cutting machine insofar as the present invention is concerned; and

Figures 2, 3, 4 and 5 show stages in the cutting of a sheet of polycarbonate or similar material.

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Referring to Figure 1, a cutter blade 1 with a chisel edge 2 is attached by bolts to a blade carrier 3. The blade carrier 3 is arranged to move up and down in the directions of arrows A-A by means of a motor and worm drive (not shown) while being journalled in bearings of which a lower one 4 is shown in the drawing, and enables the blade to be rotated about a longitudinal axis X-X. Separate drive means for rotating the blade about this longitudinal axis are arranged in an upper region of the blade carrier in a position not shown in the drawing.

The whole blade carrier system is then mounted on an overhead gantry system with servo motors connected to a final drive, and arranged to provide controlled motion in X and Y directions.

A carrier table 6 having a porouss felt carrier layer 7 includes a vacuum hold system in a known arrangement. In practice a cutting operation occurs by lowering the blade onto a workpiece and then providing relative movement of the carrier table in the direction of the arrow C. Of course it will be appreciated that the movement merely needs to be relative and the table could move longitudinally in place of the blade carrier.

The blade has an angle with reference to the carrier

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table which is optimised for the particular material to be cut. In the case of polycarbonate is has been found that an angle between the cutting edge and the blade should be in the region of 37°.

Figures 2, 3, 4 and 5 show the position of the blade 1 and its longitudinal axis X-X during a cutting sequence on a sheet of polycarbonate 8. As can be seen in the figures, the carbonate sheet is in two layers separated by transverse spacers 9, and so has significant thickness.

In practice the requirement is to make a straight cut between a first point 10 and a second point 11. Referring to Figure 2 the blade is brought down by the blade carrier into a position where its lagging edge and the longitudinal axis X-X are aligned with the first point 10 and the blade then is ahead of this point but at a lagging angle. Then movement of the workpiece relative to the blade takes the blade to the position shown in Figure 3 where the cutting edge just reaches the second point 11 on the upper surface of the workpiece.

Referring to Figure 4, it will be seen from the shaded area which represents the cut, that at the second point 11 there is an oblique cut. The invention is

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particularly concerned with solving the problem of how when using a lagging blade angle it is possible to obtain a square cut at this second end 11.

A control system (not shown) causes the blade carrier to be raised upwards so that the blade is brought clear of the workpiece. This is shown in Figure 4. The blade carrier is then rotated through a 180° angle and displaced by a distance L (see Figure 4) so that the rear edge of the blade, and hence the vertical axis X-X of the blade carrier, is aligned with a vertical line leading upwards from the second point 11. The two movements that is to say the rotary movement and the displacement L both need to occur, however it does not matter in which order this takes place.

At the end of these two movements, the position of the blade is as shown in Figure 5. It is then possible to lower the blade back into the workpiece and complete the cutting of the workpiece, that is to say cutting the final triangle of material which lies below the point 11. This is shown in Figure 5 by the reverse cross-hatch and lines below the blade.

The final cut can be achieved in some cases by merely lowering the blade onto the workpiece but in other cases

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dependant on the angle of blade and the thickness of the workpiece a movement will be necessary as between the workpiece and the blade in a longitudinal direction which is in reverse to the direction at which the main cut took place and as was shown in Figures 2 and 3.

As mentioned control means (not shown) and controlled usually by a computer control system, ensure that the various sequence of steps takes place. In particular the displacement of the blade by the amount L is dependant on the depth of the workpiece and the cutting angle of the blade and is a simple geometric relationship which can be calculated by use of dedicated software in the computer. Additionally, the starting point 10, the required length and hence end point 11 and the stopping point where the blade reaches the point 11 can all be computer controlled, as well as the reversing cut sequence.

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CLAIMS:

1. Apparatus for cutting a workpiece of sheet material comprising a carrier bed for carrying the workpiece,

a blade carrier located transversely to said carrier bed and arranged to move to and fro along an axis transverse to said carrier bed, and being rotatable about said transverse axis,

a cutting blade carried by said blade carrier and having a cutting edge located in a lagging configuration at an oblique angle to a longitudinal axis of the carrier bed,

driving means for provision of relative movement between the carrier bed and the blade carrier along said longitudinal axis to enable a line of cut to be achieved, and

control means for controlling movement of the cutting blade relative to the carrier bed to provide a line of cut between first and second points on the workpiece by starting the cut with a first cut from said first point by cutting in a direction towards said second point, and completing the cut line by starting from said second point with a second cut and cutting in a direction towards said first point.

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2. An apparatus according to Claim 1 in which the control means is arranged to orientate the cutting blade with its cutting edge in a lagging configuration with respect to the workpiece during formation of the cut from the first point towards the second point, and to be turned through 180° about said longitudinal axis so as to again be in a lagging configuration when the cut from the second point towards the first point is formed.

3. An apparatus according to Claim 1 or Claim 2 in which the cutting blade has a straight cutting edge at its front edge which is disposed at said lagging cutting angle, and a rear edge which is aligned with said longitudinal axis and hence is transverse to said carrier bed.

4. An apparatus according to any preceding claim in which the control means is arranged to control the first cut to extend the whole way from the first point to the second point, and to control the second cut to deal only with a residual triangular zone under the end of the first cut in the region of said second point.

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5. An apparatus according to any preceding claim in which the control means is arranged to locate the cutting blade in a disposition for making its second cut by carrying out the following steps:

i) on completion of the first cut the blade is removed from within the workpiece by transverse movement of the blade carrier,

ii) the blade carrier is rotated through 180° so as to present the cutting blade in the reverse direction,

iii) the blade carrier is displaced by an amount which brings the longitudinal axis of the blade into alignment with said second point, and

iv) the blade is re-introduced into the workpiece in order to complete the cut line.

6. Apparatus for cutting a workpiece substantially as herein described with reference to the accompanying drawings.

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Application No: GB 9725537.6 **Examiner:** Hal Young
Claims searched: 1-6 **Date of search:** 9 February 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B4B

Int Cl (Ed.6): B26D(1/06, 08, 10 ; 5/02)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2297511 A	(GERBER), see figs 1-7.	1 at least
X	GB 2274801 A	(MICROMATION), see figs 1,3-6 and 8.	1 at least
X	GB 2178686 A	(SAUNDERS), see whole document.	1-5
X	GB 1596134	(GERBER), see figs 1 and 3.	1,2
A	US 4094217	(BORG-WARNER)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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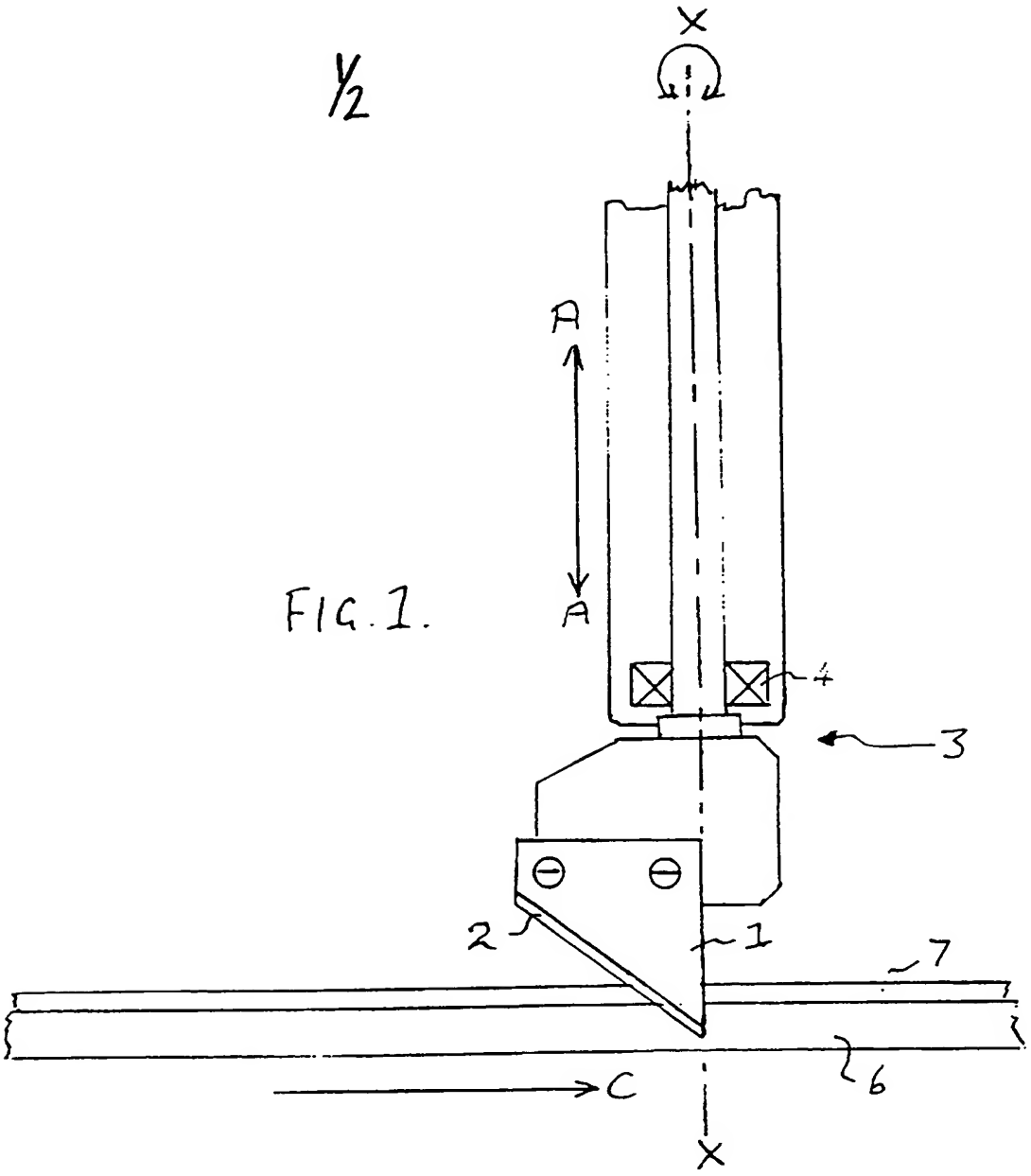

FIG. 1.

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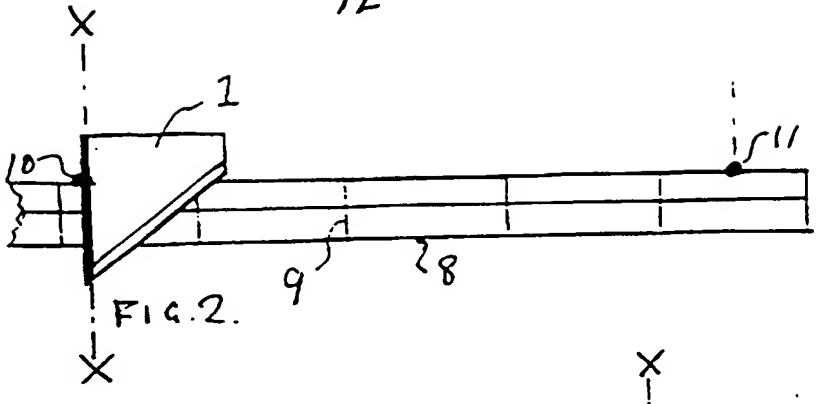

FIG.2.

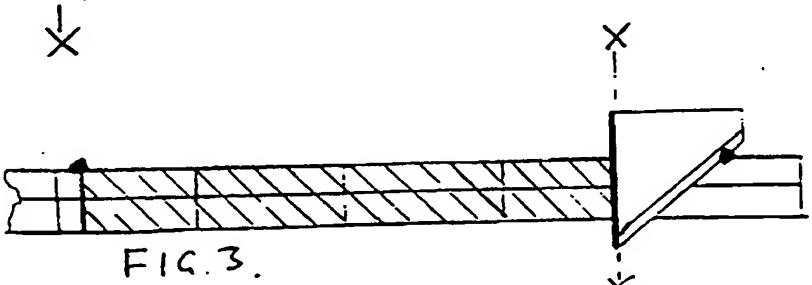

FIG.3.

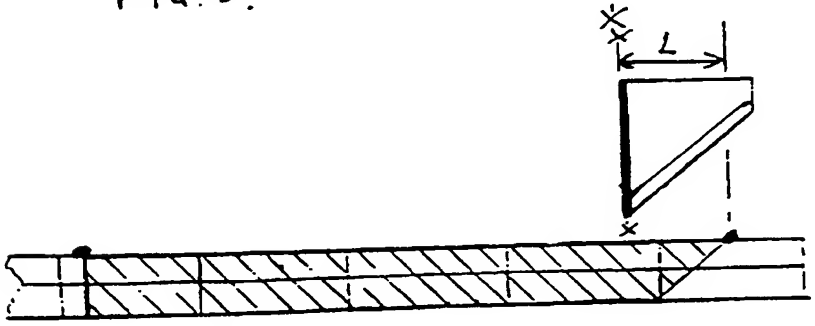

FIG.4.

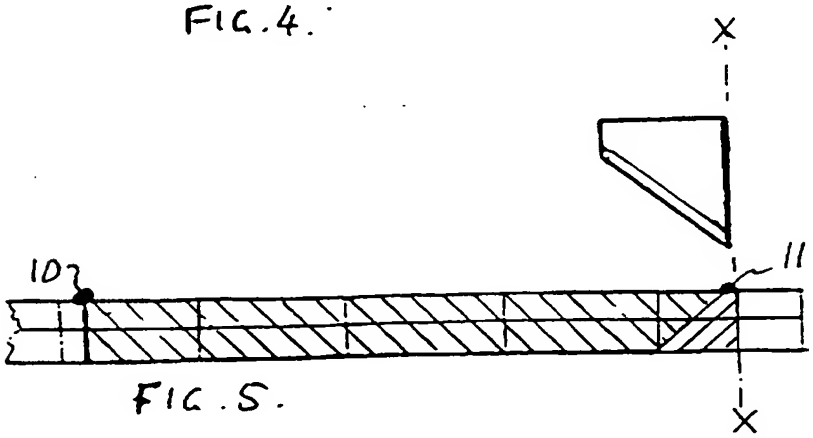

FIG.5.

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